WHAT IS CLAIMED IS:

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1. A scalable Wave Division Multiplexing (WDM) optical IP switching method, comprising the steps of:

receiving one or more optical signals, comprising a plurality of optical data packets, at an optical switch along one or more input fibers, wherein each data packet has a payload and header information and wherein each input fiber is capable of transmitting data packets on at least one input wavelength;

extracting the header information from each data packet;

converting the header information for each data packet to an electrical format;

processing the header information for each data packet at a control unit to generate control signals to control data packet payload routing through the optical switch;

routing the payload from each data packet through the optical switch in an all-optical manner to at least one desired switch output;

converting the header information for each data packet back to an optical format; and

recombining the payload and header information for each data packet for transmission out of said at least one desired switch output along one or more output fibers.

2. The method of Claim 1, wherein said routing step further comprises:

splitting each input signal at one of one or more input splitters into one or more identical signals;

forwarding from each of said input splitters one of the identical signals to each of one or more space switch blocks;

resolving potential wavelength conflicts among the plurality of data packets at said space switch blocks based on a desired output status;

forwarding from each of said switch blocks one or more wavelength resolved output signals, each to a different one of one or more input wavelength converters communicatively connected to a different one of one or more broadcast and select switches (BSSs), such that each BSS can receive as an input one of the wavelength resolved output signals;

converting to an internal wavelength the wavelengths of said plurality of data packets carried by each of the wavelength resolved output signals, at said input wavelength converters, wherein the data packets carried by each of the wavelength resolved output signals forwarded from the same switch block are converted to the same wavelength;

filtering out ASE noise generated by the wavelength converters using one or more fixed wavelength filters;

forwarding the filtered signals to their respective one of the BSSs;

resolving any time domain conflicts among the plurality of data packets at said BSSs;

forwarding one or more time resolved output signals from each of said BSSs to an output wavelength converter for each of said time resolved output signals;

converting to an output wavelength the wavelengths of said plurality of data packets at the output of said BSSs at said output wavelength converters, wherein the data packets carried by each of the time resolved output signals forwarded from the same BSS are converted to the same wavelength; and

receiving at each of one or more output multiplexers one of the time resolved output signals from each of said BSSs for multiplexing together into one of one or more output WDM signals comprising those data packets selected for output along said desired switch output.

3. The method of Claim 2, wherein the number of signals output from said input splitters is equal to the number of said input fibers.

4. The method of Claim 2, wherein there is one space switch block per input fiber.

5. The method of Claim 2, wherein each of said space switch blocks further comprise:

one or more space switch splitters for further splitting each of the one or more signals received at each switch block into a second set of one or more identical signals; and

one or more space switches for receiving one signal each from each of said second set of identical signals.

6. The method of Claim 5, wherein said resolving wavelength conflicts step further comprises selecting at each space switch within each space switch block one or more data packets from said plurality of data packets for transmission, wherein said selection is performed using a first set of SOAs to select one or more signals from each of said second set of identical signals, a coupler to couple together the selected signals, a demultiplexer to separate out the selected signals' data packets by wavelength, a second set of SOAs to select one

or more data packets for transmission, and a multiplexer to forward the selected data packets as one of said one or more wavelength resolved output signals.

7. The method of Claim 7, wherein said selecting step comprises selecting no data packets.

8. The method of Claim 7, wherein selection by said SOAs is controlled by said control signals from said control unit.

9. The method of Claim 8, wherein said control signals are based on said header information.

10. The method of Claim 2, wherein said resolving step further comprises routing one or more data packets from said plurality of data packets to a single BSS, to a plurality of BSSs, or to none of the one or more BSSs.

11. The method of Claim 2, wherein one or more of said wavelength resolved output signals comprises no data packets.

12. The method of Claim 2, wherein one or more of said time resolved output signals comprises no data packets.

13. The method of Claim 2, wherein two or more of said wavelength resolved output signals are identical.

14. The method of Claim 2, wherein two or more of said time resolved output signals are identical.

15. The method of Claim 2, wherein said input and output wavelength converters are fixed wavelength converters.

16. The method of Claim 2, wherein there is one fixed wavelength filter associated with each input wavelength converter.

17. The method of Claim 2, wherein said resolving time domain conflicts step further comprises selecting at each BSS one or more data packets from said plurality of data packets for transmission, wherein said selection is performed using a BSS input multiplexer to multiplex together said filtered signals received at each BSS, a BSS input splitter to split the multiplexed signal into one or more identical signals, an FDL buffer bank to delay one or more of said multiplexed identical signals, one or more splitters to forward duplicates of each delayed signal to a first set of SOAs to select one or more of said delayed signals, one or more couplers to couple together the selected signals, one or more demultiplexers to separate out the selected signals' data packets by wavelength, a second set of SOAs to select one or more data packets for transmission, and one or more multiplexers to forward the selected data packets as one of said one or more time resolved output signals.

18. The method of Claim 17, wherein said first set of SOAs, said one or more couplers, said one or more demultiplexers, said second set of SOAs and said one or more demultiplexers are arranged such that each BSS has one or more

channels comprising a first set of one or more SOAs, a coupler, a demultiplexer, a second set of one or more SOAs, and a multiplexer.

19. The method of Claim 17, wherein said FDL buffer bank comprises one or more FDL buffers.

20. The method of Claim 19, wherein one of said FDL buffers provides zero delay.

21. The method of Claim 19, wherein each of said FDL buffers provides a delay of one or more unit increments.

22. The method of Claim 21, wherein said unit increments are equal to the average size of said plurality of data packet payloads.

23. The method of Claim 17, wherein there is one BSS and a corresponding FDL buffer bank for each wavelength carried by said input fibers.

24. The method of Claim 2, wherein the number of said BSSs is dependent on a relationship with the maximum number of wavelengths carried by an input fiber.

25. The method of Claim 24, wherein said relationship is one to one.

26. The method of Claim 24, wherein said relationship is one to two.

27. The method of Claim 2, wherein the number of said space switch blocks equals the number of internal wavelengths.

28. The method of Claim 27, wherein said number of internal wavelengths equals the number of input fibers.

29. The method of Claim 2, wherein said optical switch is scalable up or down to take advantage of improvements in the wavelength capacity of said FDL buffer banks.

30. The method of Claim 2, wherein said space switch blocks provide for broadcast and multicast capability at the switch level.

31. The method of Claim 2, wherein said BSSs provide for broadcast and multicast capability at the switch level.

32. The method of Claim 2, wherein said desired output status is an intended output fiber for each data packet.

33. The method of Claim 1, wherein the maximum number of said input wavelengths is thirty-two.

34. The method of Claim 1, further comprising the step of amplifying each input signal.

35. The method of Claim 1, wherein said control unit controls data packet payload routing by directing the

operation of one or more space switch blocks and one or more broadcast and select switches with said control signals.

36. The method of Claim 35, wherein said control unit updates said control signals based on header information from said plurality of data packets.

37. The method of Claim 1, wherein said optical switch is scalable up or down to take advantage of improvements in the wavelength capacity of said input fibers.

38. The method of Claim 1, wherein said optical switch is used in a multi-terabit optical network.

39. The method of Claim 1, wherein said first converting step further comprises converting the header information from each data packet using a plurality of optical-to-electrical converters.

40. The method of Claim 1, wherein said control unit further comprises software instructions to control functionality of said control unit.

41. The method of Claim 1, wherein said processing step further comprises converting said generated control signals from an electrical to an optical format at one or more optical-to-electrical converters for controlling said data packet routing.

42. The method of Claim 1, wherein said second converting step further comprises converting the extracted header information from an electric format to an optical format using a plurality of electrical-to-optical converters.

43. The method of Claim 1, wherein one or more of said plurality of data packets are received at said optical switch along a common one of said input fibers and transmitted from said optical switch along a plurality of different output fibers.

44. The method of Claim 1, wherein said optical switch is independent of the rate of transmission of said plurality of data packets.

45. A scalable Wave Division Multiplexing (WDM) optical IP switch, comprising:

one or more input fibers for receiving one or more optical signals, wherein each data signal comprises a plurality of data packets, and wherein each input fiber is capable of transmitting data packets on at least one input wavelength;

a plurality of optical-to-electrical converters for converting header information from each data packet into electrical form;

a control unit for processing said electrical form header information to generate control signals to control data packet payload routing through said optical switch;

one or more input splitters for splitting each of said optical signals into one or more identical signals;

one or more space switch blocks for resolving potential wavelength conflicts among the plurality of data packets based on a desired output status;

one or more input wavelength converters for converting the wavelengths of each data packet output from said space switch blocks to one of one or more internal wavelengths;

one or more fixed wavelength filters for filtering out ASE noise generated by said input wavelength converters;

one or more broadcast and select switches (BSSs) for resolving any time domain conflicts among the plurality of data packets;

one or more output wavelength converters for converting the wavelengths of said plurality of data packets at the output of said BSSs to one of one or more output wavelengths;

a plurality of output electrical-to-optical converters for converting said electric form header information for each data packet back to an optical format;

one or more control electrical-to-optical converters for converting said generated control signals into an optical format to control said data packet routing; and

one or more output multiplexers for multiplexing together into one of one or more output WDM signals the header information and payload of those data packets from said plurality of data packets selected for output along said desired switch output.

46. The system of Claim 45, wherein the number of signals output from said input splitters is equal to the number of said one or more input fibers.

47. The system of Claim 45, wherein there is one space switch block per input fiber.

48. The system of Claim 45, wherein each of said space switch blocks further comprise:

one or more space switch splitters for further splitting each of the one or more signals received at each switch block into a second set of one or more identical signals; and

one or more space switches for receiving one signal each from each of said second set of identical signals.

49. The system of Claim 48, wherein each of said space switches further comprise:

a first set of Semiconductor Optical Amplifiers (SOAs) to select one or more signals from each of said second set of identical signals;

a coupler to couple together said selected signals;

a demultiplexer to separate out the selected signals' data packets by wavelength;

a second set of SOAs to select one or more data packets for transmission; and

a multiplexer to forward the selected data packets as one of one or more wavelength resolved output signals.

50. The system of Claim 49, wherein selection by said first and second set of SOAs is controlled by said control signals from said control unit.

51. The system of Claim 49, wherein said control signals are based on said header information.

52. The system of Claim 45, wherein said input and output wavelength converters are fixed wavelength converters.

53. The system of Claim 45, wherein there is one fixed wavelength filter associated with each input wavelength converter.

54. The system of Claim 45, wherein each of said BSSs further comprises:

a BSS input multiplexer to multiplex together said filtered signals received at each BSS;

a BSS input splitter to split the multiplexed signal into one or more identical signals;

an FDL buffer bank to delay one or more of said multiplexed identical signals;

one or more splitters to forward duplicates of each delayed signal to a first set of SOAs to select one or more of said delayed signals;

one or more couplers to couple together the selected signals;

one or more demultiplexers to separate out the selected signals' data packets by wavelength;

a second set of SOAs to select one or more data packets for transmission; and

one or more multiplexers to forward the selected data packets as one of one or more time resolved output signals.

55. The system of Claim 54, wherein said first set of SOAs, said one or more couplers, said one or more demultiplexers, said second set of SOAs and said one or more demultiplexers are arranged such that each BSS has one or more channels comprising a first set of one or more SOAs, a coupler, a demultiplexer, a second set of one or more SOAs, and a multiplexer.

56. The system of Claim 54, wherein said FDL buffer bank comprises one or more FDL buffers.

57. The system of Claim 56, wherein one of said FDL buffers provides zero delay.

58. The system of Claim 57, wherein each of said FDL buffers provides a delay of one or more unit increments.

59. The system of Claim 58, wherein said unit increments are equal to the average size of said plurality of data packet payloads.

60. The system of Claim 54, wherein there is one BSS and a corresponding FDL buffer bank for each wavelength carried by said input fibers.

61. The system of Claim 45, wherein the number of said BSSs is dependent on a relationship with the maximum number of wavelengths carried by an input fiber.

62. The system of Claim 61, wherein said relationship is one to one.

63. The system of Claim 61, wherein said relationship is one to two.

64. The system of Claim 45, wherein the number of said space switch blocks equals the number of internal wavelengths.

65. The system of Claim 64, wherein said number of internal wavelengths equals the number of input fibers.

66. The system of Claim 45, wherein said optical switch is scalable up or down to take advantage of improvements in the wavelength capacity of said FDL buffer banks.

67. The system of Claim 45, wherein said space switch blocks provide for broadcast and multicast capability at the switch level.

68. The system of Claim 45, wherein said BSSs provide for broadcast and multicast capability at the switch level.

69. The system of Claim 45, wherein the maximum number of said input wavelengths is thirty-two.

70. The system of Claim 45, wherein said desired output status is an intended output fiber for each data packet.

71. The system of Claim 45, further comprising one or more pre-amplifiers for amplifying each optical signal at the switch input.

72. The system of Claim 45, wherein said control unit controls data packet payload routing by directing the operation of said space switch blocks and said broadcast and select switches with said control signals.

73. The system of Claim 72, wherein said control unit updates said control signals based on header information from said plurality of data packets.

74. The system of Claim 45, wherein said optical switch is scalable up or down to take advantage of improvements in the wavelength capacity of said input fibers.

75. The system of Claim 45, wherein said optical switch is used in a multi-terabit optical network.

76. The system of Claim 45, wherein said control unit further comprises software instructions to control functionality of said control unit.

77. The system of Claim 45, wherein said optical switch is independent of the rate of transmission of said plurality of data packets.